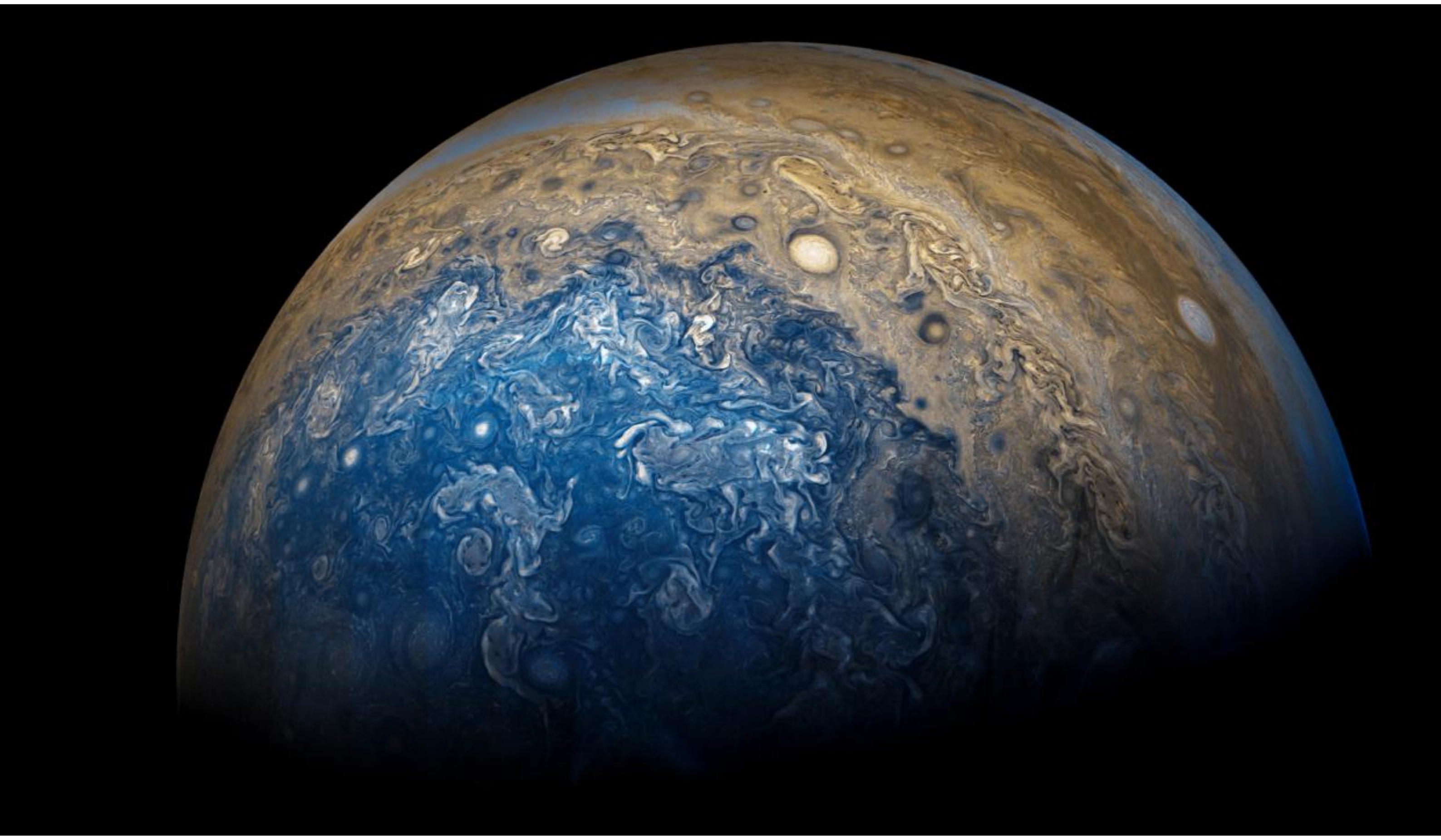
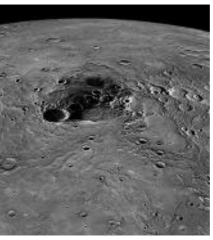
Jane Goodall's roots&shoots

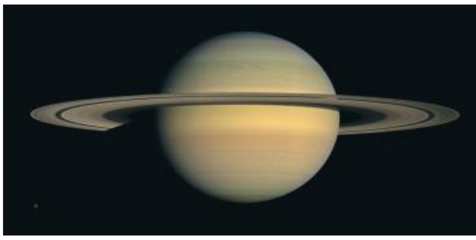
Incredible Universe

VOLUME 1 : The Solar System

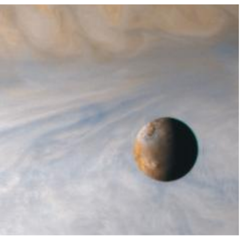
Teacher Resources

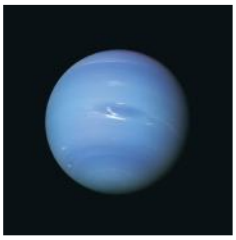


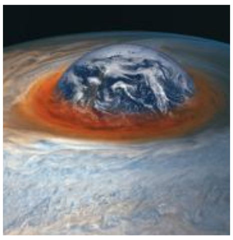


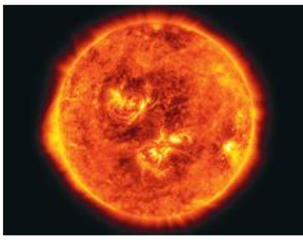


Jane Goodall Institute
Australia









Contents

All images from Incredible Universe Volume 1 - The Solar System. See Image Credits page for details.

The Jane Goodall Institute Australia and The Royal Institute Australia acknowledge with deep respect the First Nations of this land we now call Australia.

We recognise their continuing connection to Country and acknowledge that they never ceded sovereignty. We thank them for caring for our living landscapes since time immemorial.

We acknowledge and respect the continuation of cultural, spiritual and educational practices. We pay our respects to Elders past and present and emerging and extend that respect to all First Nations people reading this book.

About the Roots & Shoots program

Congratulations for being a Roots & Shoots school!

Roots & Shoots is a global community action program founded by Dr. Jane Goodall in 1991. The program aims to inspire, empower and encourage young people all over the world.

It shows them how to follow their passions, take actions together and become the change our world needs. That way, we can all ensure a better future for people, animals and the environment.

About the resource box

The Roots & Shoots Resource Box is designed for use by teachers and students in primary schools, or by homeschoolers. As well as the four stunning books within, the Box offers several exciting learning opportunities to further foster optimism for our future:

WOODiWILD (woodiwild.org) enables schools to join a national tree planting program, while also raising funds for your own school needs.

One Earth Film Festival (onearthfilmfestival.org) enables young story tellers to create throught provoking, transformative films to understand climate change, sustainability and the power of human involvement.

AIME and IMAGI-NATION UNIVERSITY offer mentoring to young changemakers focusing on creating a fairer world in school and beyond. Head to aimementoring.com/secret-school-site to learn more.

This teacher resource

This resource aims to more deeply engage teachers and students with the amazing and inspiring content of the 2021 Roots & Shoots Resource Box. Moving beyond simply reading and viewing the beautiful pages of these books, through these learning sequences it is hoped all can be inspired to take action towards a better future.

The Amazing Universe Volume 1- The Solar System book is authored by experts and is an important teacher professional learning resource. It supports teachers towards achieving **Australian Professional Standards for Teachers Standard 2: Know the content and how to teach it**.

Teachers can choose to undertake part, or all, of these learning sequences, however it is recommended to follow the complete sequence in order to achieve the best outcomes.

Completing the activities in these Learning Sequences will enable students:

- to achieve outcomes in upper primary Science courses – see Page 7 for full curriculum links
- to engage deeply with the content of the Incredible Universe Volume 1: The Solar System

These learning sequences apply the 5 E's instructional model – see page 2 for a more complete summary of these pedagogical approaches.

Pedagogical approaches applied in these resources

These learning sequences embed inquiry-based learning into a modified 5Es instructional model (Bybee, 1997), with the five phases: Engage, Explore, Explain, Elaborate and Evaluate.

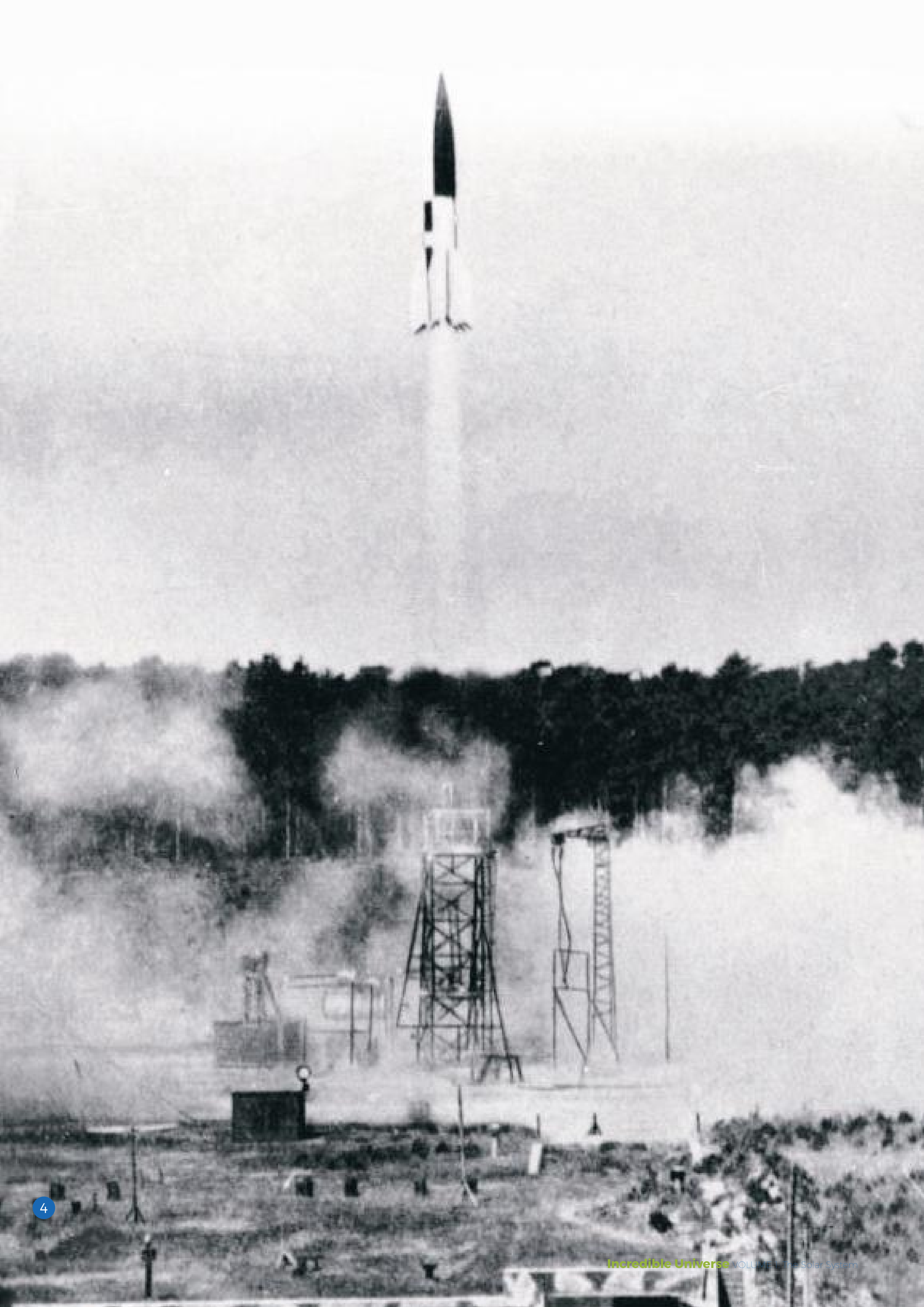
TIME	5E's	Main ideas / skills
	Engage	Identifying and defining Connect past with present Create interest
	Explore	Researching and planning Encourage creative thinking Give common set of experiences Challenge own ideas
	Explain	Apply new vocabulary
	Elaborate	Producing and implementing Apply to new experiences
	Evaluate	Testing and evaluating. Have you changed your thinking?

About The Royal Institute Australia

The Royal Institution of Australia (RiAus) is an independent charity established expressly to advocate for science. We are among this nation’s few remaining independent science voices and its last independent science publisher. We believe that science matters. We have an opportunity to use science as a path to the future for our children, our manufacturers, and our businesses, to stay competitive on a global stage.

RiAus produces Cosmos, Australia’s last locally produced print science magazine, and the daily independent science news site cosmosmagazine.com. Early in 2021 we launched the weekly science news e-publication Cosmos Weekly, which is dedicated to science’s role in the issues of the day.

Perhaps the most important thing we do at RiAus is provide free science teaching resources for schools around the country. The resources aim to support STEM teaching and are mapped to the Australian National Curriculum (v8.3). The Education platform is supported by the South Australian Department for Education.



Introduction to Incredible Universe Volume 1: The Solar System

Since prehistory, humankind has gazed with wonder at the night sky.

Beyond admiring the beauty of those small, twinkling lights, there has always been a desire by the thinkers through the ages to study and to catalogue, and by doing so, to increase our knowledge and understanding of the jewels of the infinite starscape above.

Out of the darkness of the Second World War came the technology for humanity's most stupendous achievement to date: two astronauts from the Apollo 11 spacecraft landing on the Moon in July 1969, followed by their safe return to Earth. Through this undertaking, we gained a new perspective, not only of ourselves, but of the fragile blue orb upon which, all of our lives depend.

The five decades since the last lunar landing have seen astronomers and space agencies around the globe explore many of the most awe-inspiring questions of science, among them: our place in the Universe, the scale of space and the age of all that we can see.

Humankind has always had an innate curiosity which drives our need to investigate, question and enquire.

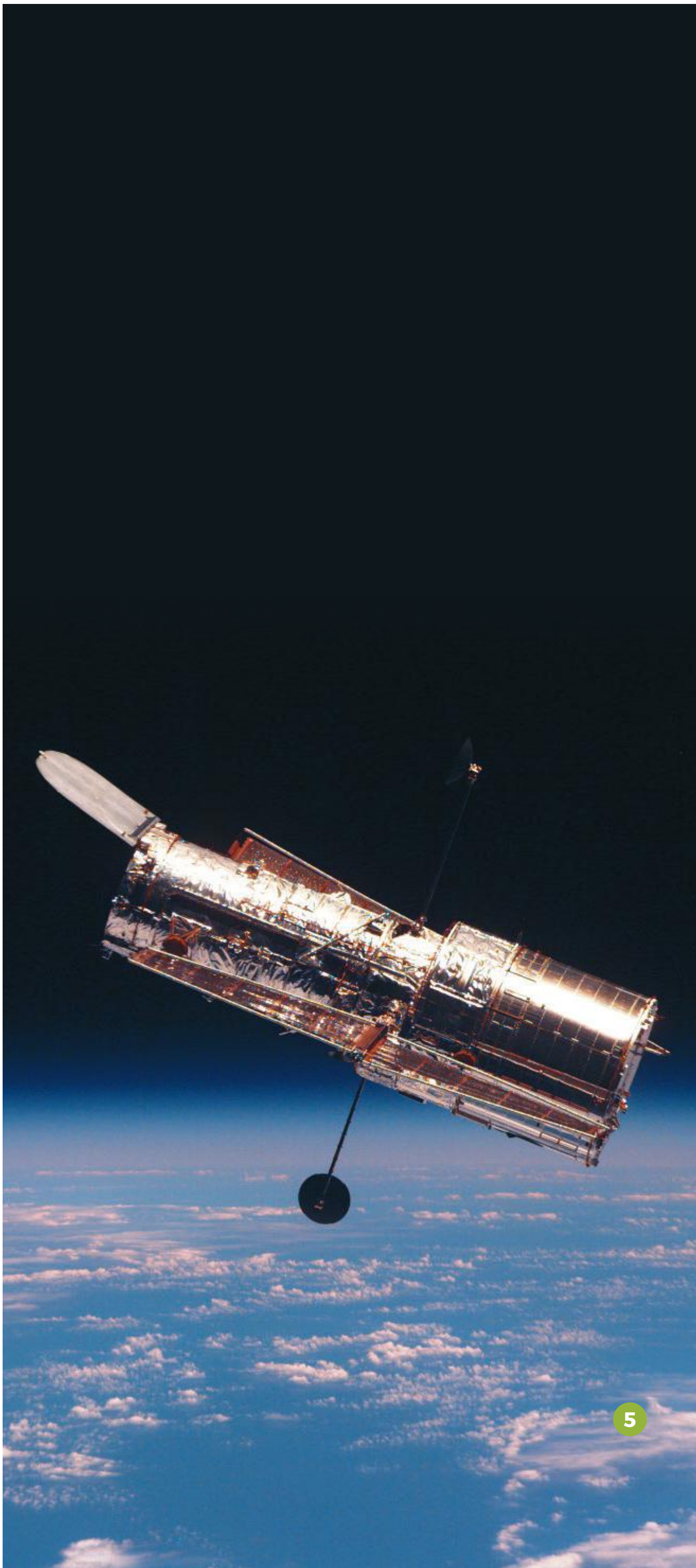
Our eyes will forever be looking upwards and outwards, and our rapid advances in technologies and scientific processes in recent decades have accelerated the quest to find out more about our own planet and the Solar System in which it resides.

We are on the precipice of an exciting new wave of exploration and discovery, with return missions to the Moon planned and the real prospect of humans landing on Mars dawning on the horizon.

The authors hope this book will enthuse tomorrow's astronomers and space scientists by inspiring awe at the wonder of it all: the seemingly infinite scale, complexity and majesty of our incredible Universe.

The study of space offers an almost limitless field for discovery, and one which the reader can be part.

Gaze upwards, admire and question.



Useful links and professional learning

Roots & Shoots

If you've an idea to benefit animals, people and environment – no matter how big or small – we want to help you. Across Australia, our Roots & Shoots local leaders are ready to guide our members in planning, creating and realising your activity. Whether you're an individual, youth group or school we provide the skills, tools and mentoring to make your activity a success.

RiAUS The Royal Institute of Australia

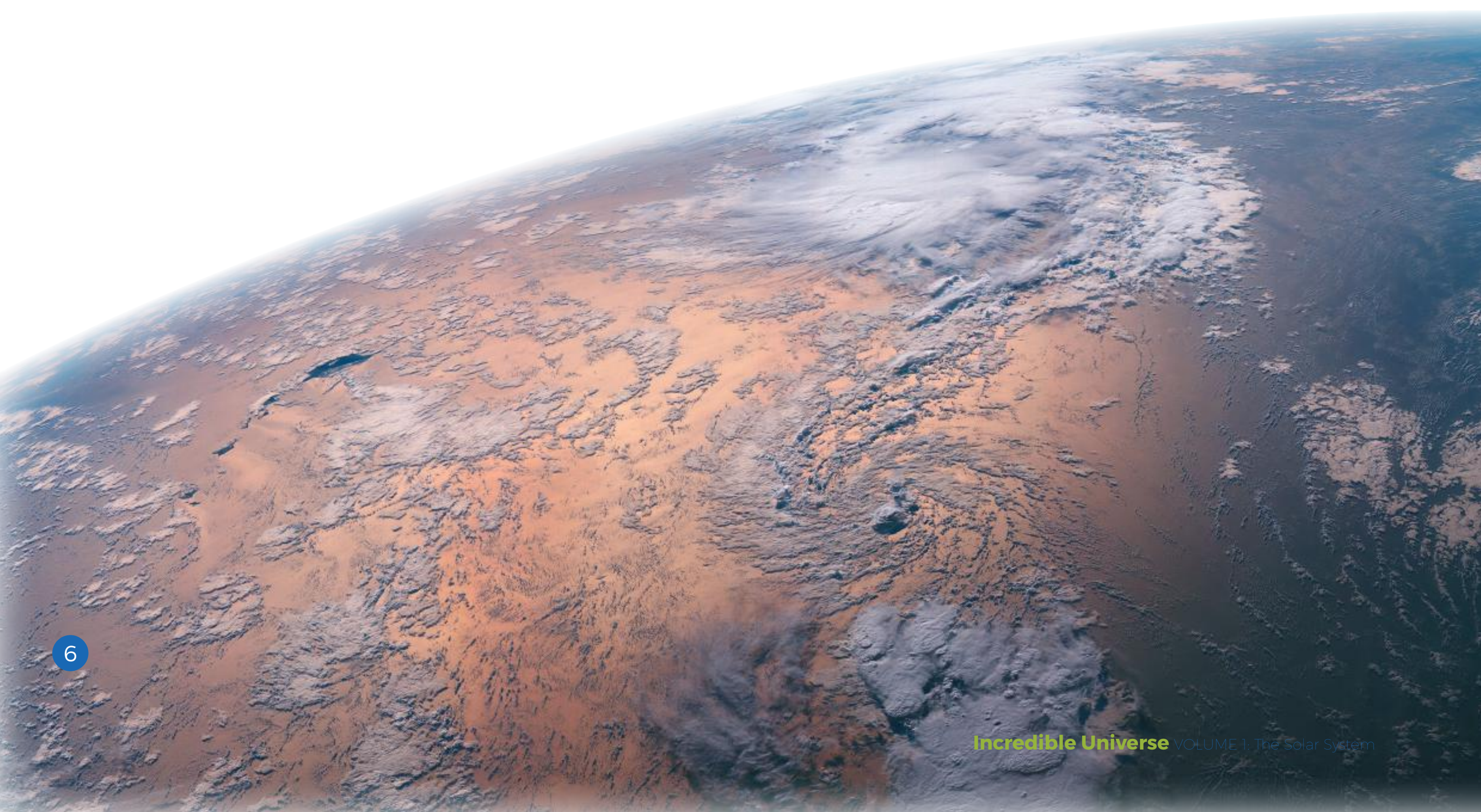
Head to our education platform to access free resources which include a regularly updated collection of videos, articles, and student activities. The selection of resources is designed for R-12 students and focus on Science as a Human Endeavour to support, inspire and excite students about all things STEM. Our resources are mapped to the Australian National Curriculum (v8.3), helping to take the stress out of content planning and creation. The Education platform brings that real-world relevance to classroom resources, activities, and workshops for students, as well as professional development for educators themselves.

Austrum You Tube channel

Explore the Solar System online and access hundreds of specially-crafted films that compliment this book.

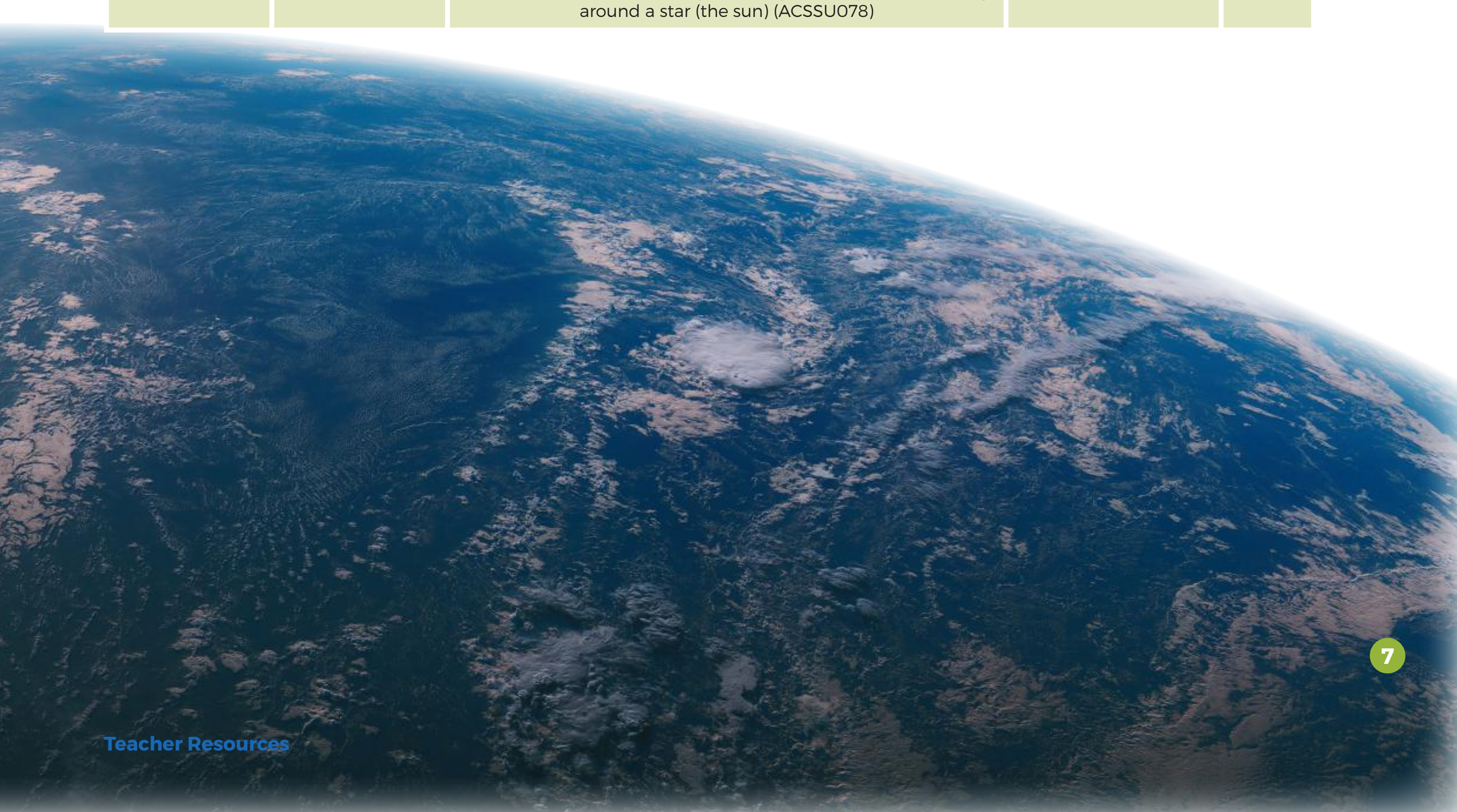
Australian Curriculum

These Learning Sequences are designed to be used by teachers and students across Australia and are therefore linked to Australian Curriculum outcomes. For latest developments and additional resources to support the teaching of Australian Curriculum, head to that website.



Summary of learning sequences

Learning sequence	Learning intentions	Main ACARA curriculum links	Main learning experiences	Page
The observable Universe	Introduce students to some of the key terms involved in space exploration.	*Foundation Science:* Daily and seasonal changes in our environment affect everyday life (ACSSU004) *Year 1 Science:* Observable changes occur in the sky and landscape (ACSSU019) *Year 3 Science:* Earth's rotation on its axis causes regular changes, including night and day (ACSSU048) *Year 5 Science:* The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)	Video Vocabulary bingo	9
Unimaginable scale	Students should gain an understanding of the scale of the Solar System.	*Foundation Science:* Daily and seasonal changes in our environment affect everyday life (ACSSU004) *Year 3 Science:* Earth's rotation on its axis causes regular changes, including night and day (ACSSU048) *Year 5 Science:* The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)	Draw to scale Video Work as a team to create a model	12
Our Solar System	Students can identify the planets of the Solar System and describe some of their features.	*Foundation Science:* Daily and seasonal changes in our environment affect everyday life (ACSSU004) *Year 1 Science:* Observable changes occur in the sky and landscape (ACSSU019) *Year 3 Science:* Earth's rotation on its axis causes regular changes, including night and day (ACSSU048) *Year 4 Science:* Earth's surface changes over time as a result of natural processes and human activity (ACSSU075) *Year 5 Science:* The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)	Make a model Video Research and create a presentation	14



Learning sequence	Learning intentions	Main ACARA curriculum links	Main learning experiences	Page
Exploring Mars	Students can apply their knowledge of forces and the features of Mars to design a lander.	*Foundation Science:* Daily and seasonal changes in our environment affect everyday life (ACSSU004) *Foundation Science:* The way objects move depends on a variety of factors, including their size and shape (ACSSU005) *Year 2 Science:* A push or a pull affects how an object moves or changes shape (ACSSU033) *Year 3 Science:* Earth's rotation on its axis causes regular changes, including night and day (ACSSU048) *Year 4 Science:* Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076) *Year 5 Science:* The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)	Video Apply the design process as a team	17
Moving to Mars	Students can identify the requirements for sustaining life. Students use this knowledge to design and construct a model habitat for life on mars.	*Foundation Science:* Living things have basic needs, including food and water (ACSSU002) *Foundation Science:* Daily and seasonal changes in our environment affect everyday life (ACSSU004) *Foundation Science:* Objects are made of materials that have observable properties (ACSSU003) *Year 1 Science:* Observable changes occur in the sky and landscape (ACSSU019) *Year 3 Science:* Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ACSSU044) *Year 3 Science:* Earth's rotation on its axis causes regular changes, including night and day (ACSSU048) *Year 4 Science:* Living things depend on each other and the environment to survive (ACSSU073) *Year 4 Science:* Natural and processed materials have a range of physical properties that can influence their use (ACSSU074) *Year 5 Science:* Living things have structural features and adaptations that help them to survive in their environment (ACSSU043) *Year 5 Science:* The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078) *Year 6 Science:* The growth and survival of living things are affected by physical conditions of their environment (ACSSU078)	Design a 3D model of a habitat building Research and create a presentation	21

Learning sequence:

The Observable Universe

Learning intentions:

Introduce students to some of the key terms involved in space exploration.

Success criteria:

All must be able to identify or describe some observable features visible in the sky.

Most should be able to describe Earth's position within the Solar System and state some of the other features within it.

Some could state some of the objects within the wider Universe, describe what they are and their identifiable features.

Prior knowledge:

N/A – this lesson sets the foundations for future learning.

KEY VOCABULARY

Outlined in this activity see Appendix 1 and Appendix 2.

SPECIAL NOTES

Icons like this:

QR indicate a QR code link to online resources found in Appendix 3

Learning sequence: The Observable Universe

Content	Teaching learning and assessment	Resources
ENGAGE	Show students the video Lesson 1 The observable universe of Alan Duffy – Lesson 1. In this he briefly explains the origin of the universe and some key features within it.	QR code 1
EXPLORE	Each student should choose one key word/phrase from within this clip that they didn't know before. They should then use the resources available to them (internet, books etc.) to find out more about this term.	
EXPLAIN	Students should form small groups where each student has a different word. They should then take turns to explain their key word to others in the group. This explanation should only be about 1 minute long. Next, the others in the group should ask any questions about the explanation to the student. If they can't answer it then time should be given for the group to find the answer.	
ELABORATE	Provide the list of key words below (Appendix 1) and ask the students to write a definition for each of them in groups (the intention is that some of them will already be done in the previous section, they may already know some of the definitions, and others can be researched together).	Appendix 1
EVALUATE	Bingo – Give students a 3x3 grid and ask them to write a key space-term from the list below (Appendix 1) in each of the cells. Read out each definition (Appendix 2) one at a time. If the students have the word corresponding to that definition they cross it out on their grid. When the student has all 9 terms complete, they shout bingo. Terms can then be cross-checked with the class.	Appendix 1 Appendix 2
EXTEND	Students can create their own game of definition bingo using their definitions and key words from previous activities, adding to it any new terms they've learnt.	

Appendix 1: Key words

planet	star	big bang	galaxy	Milky Way
meteoroid	comet	moon	nebula	Earth
Astronomer	Sun	solar system	day	night
Mars	Astronaut	satellite	1 year	light year
eclipse	seasons	orbit	1 astronomical unit	gravity
sunrise	sunset	24 hours	meteor	Astrophysicist

Appendix 2: Key word definitions

1 astronomical unit	A unit of distance used in space, equivalent to the distance between the Sun and Earth
1 year	The time it takes for the Earth to orbit once around the Sun
24 hours	The time it takes for the Earth to rotate once on its own axis
Astronaut	A person who is trained to travel in a spacecraft
Astronomer	A scientist who studies space. They observe astronomical objects such as stars, planets, moons, comets and galaxies
Astrophysicist	A scientist who studies space. They apply the laws of physics to try to understand concepts such as the birth, life and death of stars, planets, galaxies, nebulae and more
Big bang	The believed origin of the universe. All matter that exists now was once in a hot, dense state when it suddenly started expanding rapidly
Comet	An object in space made of ice and dust. When it passes near a star, some of the ice melts and streaks behind it like a tail
Day	The time on one side of the Earth when it is facing the Sun
Earth	The planet we live on. The only known planet with life
Eclipse	When part of the Earth goes dark during the day because the Moon passes directly between the Sun and the Earth, casting a shadow
Galaxy	A system of millions or billions of stars, together with gas and dust, held together by gravity
Gravity	The force caused by the Earth (or anything with mass) that pulls any object towards its centre
Light year	A unit of measurement used in space because distances are so large. It is equal to 9.5 quadrillion (that's 95 followed by 14 zeroes) meters and is the distance light can travel in one year
Mars	The next planet from the Sun after Earth. It is also called the Red Planet
Meteor	A meteoroid that enters the Earth's atmosphere. Friction in the atmosphere causes it to glow and appear as a streak of light in the sky
Meteoroid	A small rocky or metallic body in outer space
Milky Way	The galaxy Earth is in
Moon	A natural object that orbits a planet
Nebula	A cloud of dust and gas in space where stars are born
Night	The time on one side of the Earth when it is facing away from the Sun
Orbit	The curved path of a celestial object or satellite around a star, planet or moon
Planet	An astronomical body that is large enough to become rounded by its own gravity. It a star or stellar remnant
Satellite	An object orbiting a planet. They can be natural (like the moon) or human-made (like the International Space Station)
Seasons	The four times of the year with different weather patterns and daylight hours caused by the tilt of the Earth in relation to the Sun
Solar system	All the planets, moons, asteroids, meteoroids, comets and more that orbit the Sun make this up
Star	A massive object in the sky, held together by its own gravity. It is continuously undergoing nuclear reactions which cause it to emit light, heat and other waves of energy
Sun	The star in our solar system. The Earth orbits this
Sunrise	The time experienced as the Earth turns towards the Sun
Sunset	The time experienced as the Earth turns away from the Sun

Learning sequence:
Unimaginable Scale

Learning intention:

Students should gain an understanding of the scale of the Solar System.

Success criteria:

All must recognise the Earth's position within the Solar System.

Most should be able to describe (relatively) how close or far from the Sun bodies are in the Solar System.

Some could model the relative distance between Earth, other planets in the Solar System and the Sun.

Prior knowledge:

The planets within the Solar System and definitions of other celestial bodies such as dwarf planets, Sun, moons, asteroids and comets.

Fractions including 1/2, 1/4, 1/8, 1/16 and 1/32.

KEY VOCABULARY

Outlined in this activity see Appendix 1 and Appendix 2, also

Astronomical unit

Celestial bodies

SPECIAL NOTES

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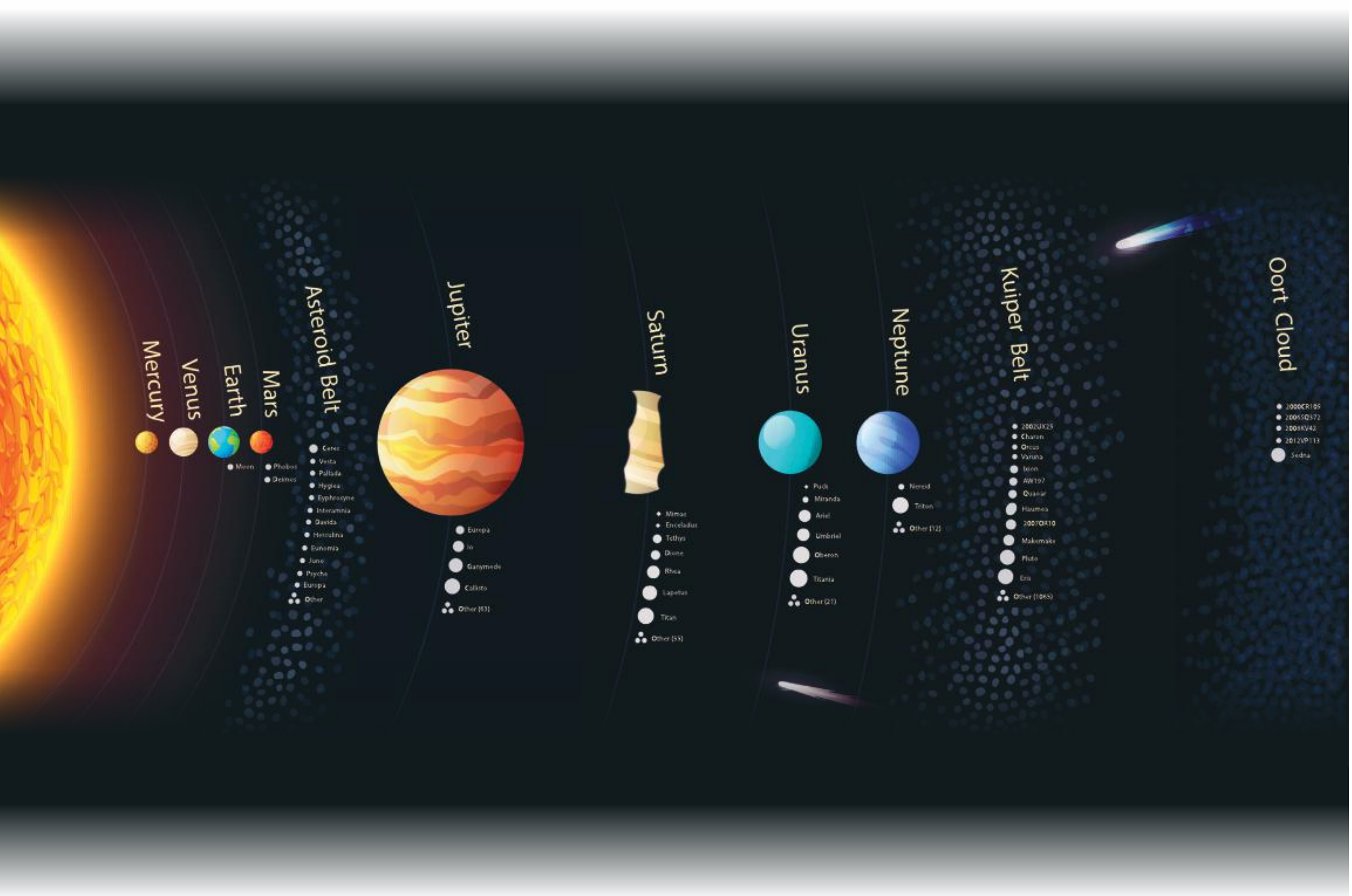

Learning sequence: Unimaginable Scale

Content	Teaching learning and assessment	Resources
ENGAGE	In pairs, take a sheet of flipchart paper cut in half length-ways. Draw and label the Sun at one end and the Kuiper Belt at the other – this represents the boundaries of the Solar System. Ask students to draw in where they think the planets within the Solar System are positioned in this space.	
EXPLORE	Watch the video [Lesson 2 Unimaginable scale]() of Professor Alan Duffy explaining the scale of the Solar System and beyond. Record any questions arising during this video and also what surprised students.	QR [code 2]()
EXPLAIN	Now turn the flipchart paper over and again, draw the Sun at one end and the Kuiper Belt at the other (note: keep the Sun really close to the edge so other planets can fit in – just a line along the edge of the paper would do!). This activity will now show the actual scale of the distances between the planets: • Fold the paper in half (and unfold). On this line, mark Uranus. • Fold the paper in half between the Sun and Uranus. On this line, mark Saturn. • Fold the paper in half between the Kuiper belt and Uranus. On this line, mark Neptune. • Fold the paper in half from the Sun to Saturn. Mark this as Jupiter. • Fold the paper in half from the Sun to Jupiter. Mark this as the asteroid belt. • Fold the paper in half from the Sun to the asteroid belt. Mark this as Mars. • All the remaining inner planets (Earth, Venus and Mercury) are between Mars and the Sun. So when you hear them called the "inner planets," there is a good reason why!	
ELABORATE	Discuss how the model Solar System compares to the students' initial estimate. Add fractions to the model, where the Sun is 0 and the Kuiper belt is 1. Light travels at 300,000,000 meters every second. Even at this speed, it still takes 8 minutes and 19 seconds to travel from the Sun to Earth (this distance is called 1 astronomical unit, or 1 AU). This means that when we see the Sun, we are actually seeing it as it was 8.3 minutes ago. Estimate how long it would take light to travel to the other planets in the Solar System (your fractions will help you with this).	
EVALUATE	This activity is best completed in a large space, like the oval. Ask students to each take on a role of one of the planets in the Solar System, the Sun, the asteroid belt and the Kuiper Belt. For more students, multiple can be the asteroid belts or some students can be moons, estimate their distance from their planet. Students should now organise themselves to be the distances from the Sun as in the model.	
Extend	Extend the model by getting planet-students to orbit around the Sun, and moon-students to orbit around their planet. This could also be used to reinforce day and night learning as well as eclipses. To further explore the scale of the Universe, watch and discuss [The Scale of the Universe 2]() video For an activity to model the relative sizes of the planets, visit the webpage [Why are stars, planets and moons round?]()	QR [code 3]() QR [code 4]()

Learning sequence:

Our Solar System

Learning intention:

Students can identify the planets of the Solar System and describe some of their features.

Success criteria:

All must state, in order, the planets of the Solar System.

Most should state the outer and inner planets and describe some features of the planets including the approximate sizes and length of year.

Some could describe detailed features of the planets, including composition, appearance and length of day and year.

Prior knowledge:

The planets in our Solar System orbit the Sun. These are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

KEY VOCABULARY

Outlined in this activity see Appendix 1 and Appendix 2.

SPECIAL NOTES

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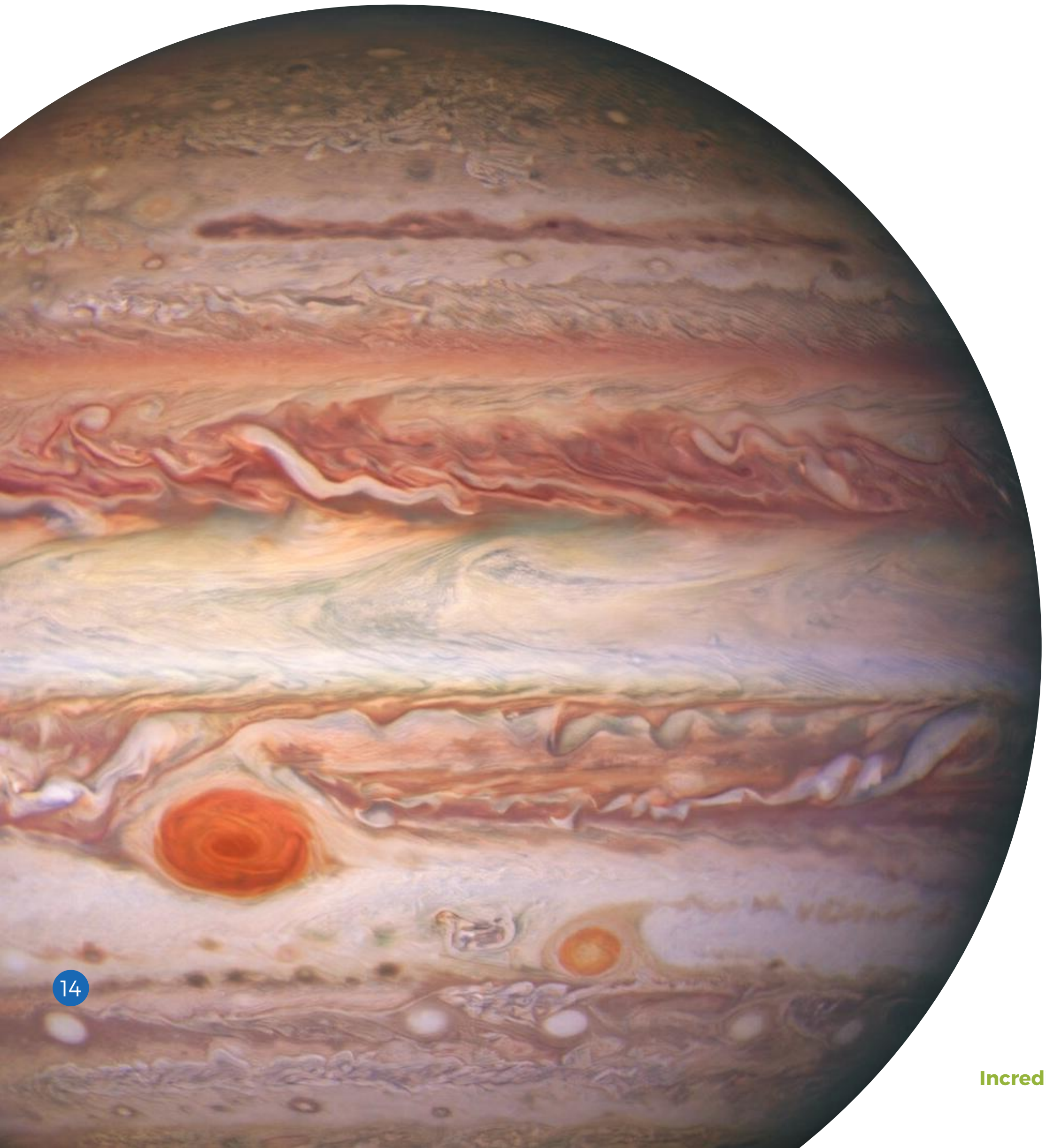
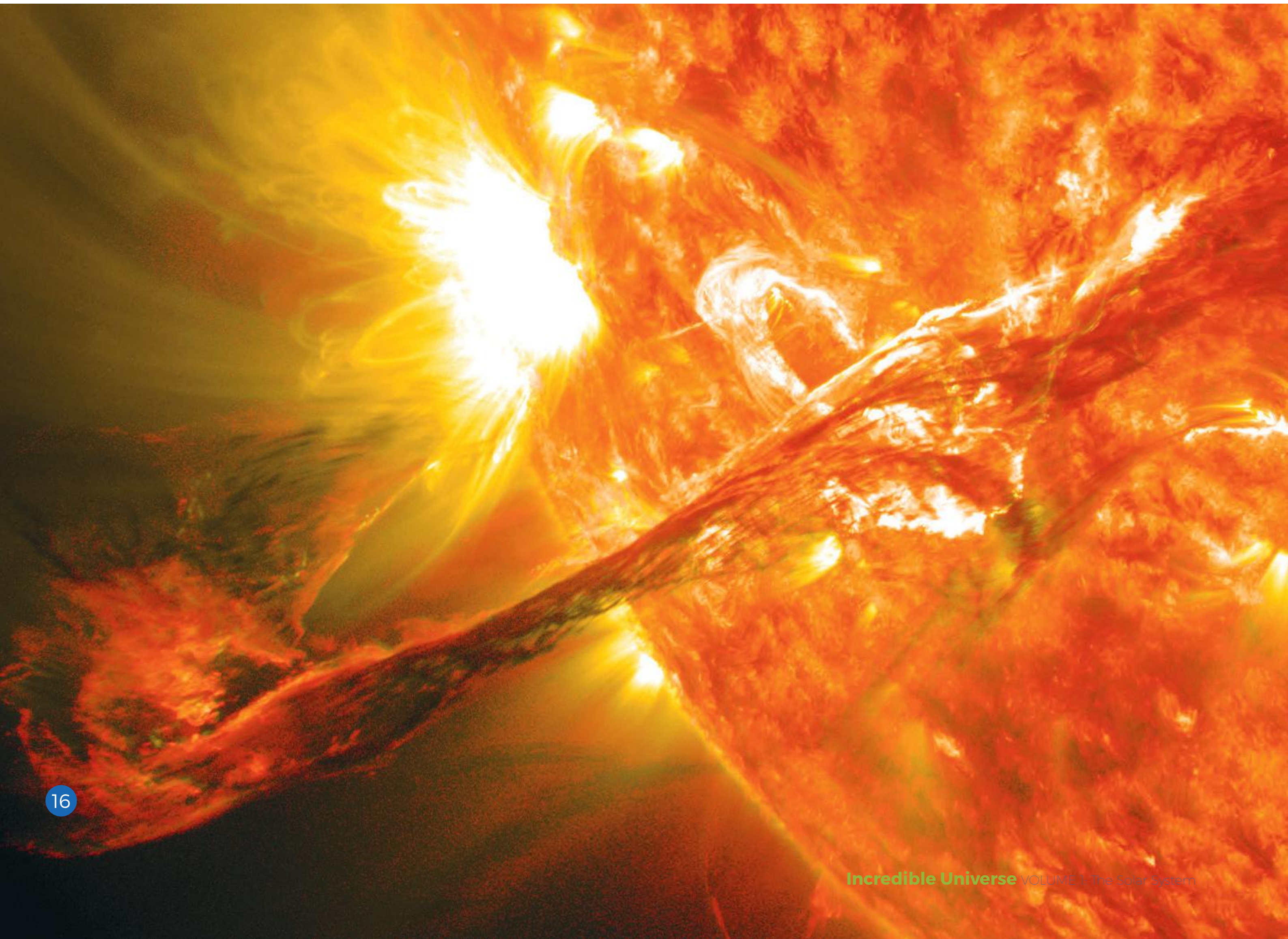


Learning sequence: Our Solar System

Content	Teaching learning and assessment	Resources
ENGAGE	All the planets in the Solar System are different sizes. Explore this further by making a scale model: **You will need:** • Plasticine (as much as you can get, ideally 1 kg) • Plastic knife • Table covering (it can get messy) • Sticky notes/labels **Method:** 1. Using all of the plasticine, make 10 equal balls. 2. Combine 6 of the balls. This is Jupiter. Label it and sit it aside. 3. Combine 3 of the remaining balls. This is part of Saturn. Label it but keep it nearby. 4. Divide the one remaining ball into 10. 5. Combine 5 of them together and add it to Saturn. 6. Take 2 of them and combine them. This is Neptune. Label it and sit it aside. 7. Take another 2 and combine them. This is Uranus. Label it and sit it aside. 8. With the ball that is left, make 10 equal sized balls. 9. Squash 9 of them together and add them to Saturn. Saturn is now complete. Sit it aside. 10. Divide the remaining ball in 2. 11. One of them is Earth. Label it and sit it aside. 12. Diving the remaining ball into 10 (it's getting tricky, right?) 13. Combine 9 of them. This is Venus. Label it and sit it aside. 14. Make 10 balls out of the 1 that is left. 15. Use 9 of them to create Mars. Label it and sit it aside. 16. Divide the ball that is left into 10. 17. Use 9 of them to create Mercury. Label it and sit it aside. 18. The ball that is left is Pluto. Label it (if you can find it). 19. Arrange the planets in the appropriate order from the Sun – you could put them on the model from Lesson 2.	
EXPLORE	Watch the videos of Professor Alan Duffy as he explains the features of the planets in the Solar System.	
	1/3 – The planets Lesson 3 Our solar system: The planets (video)	code 5
	2/3 – Model the solar system Lesson 3 Our solar system: Model the solar system (video)	code 6
	3/3 – Earth's rotations Lesson 3 Our solar system: Earths rotations (video)	code 7
	Note down any questions or surprises.	

Learning sequence: Our Solar System (continued)

Content	Teaching learning and assessment	Resources
EXPLAIN	Choose one of the planets in the Solar System, Pluto, the asteroid belt or the Kuiper belt. Use the relevant chapter in the book and other resources available to you to learn more about it. Create a presentation to teach others about your celestial body. This can be in the form of a PowerPoint, a poster, a leaflet, a film, a podcast, a news article or other.	
ELABORATE	Choose of the presentations you have seen by others in your class and write down three questions you have: what else would you like to know about this body? Use the available resources to find answers to these questions then discuss them with the presenter.	
EVALUATE	Consider what you've learnt about the planets in the Solar System. What planet(s) is suitable for life to exist? What makes you say that?	
EXTEND	Use the internet to learn about exoplanets (planets orbiting other stars). Find out about their size, composition, appearance, length of year and how suitable they would be to host life. Some examples include: Kepler-186f, Osiris (HD 209458 b), 51 Pegasi b, CoRoT 7b, Kepler-22b and 55 Cancri e.	



Learning sequence:
Exploring Mars

Learning intention:

Students can apply their knowledge of forces and the features of Mars to design a lander.

Success criteria:

All must be able to describe the surface of Mars, comparing it to Earth.

Most should be able to discuss how gravity would be different on Mars.

Some could describe the features required of a lander on Mars using terms such as forces, friction, gravity, weight and mass.

KEY VOCABULARY

Outlined in this activity see Appendix 1 and Appendix 2, also

Gravity

Mass

Weight

Friction

SPECIAL NOTES

Icons like this:

QR indicate a QR code link to online resources found in Appendix 3

Learning sequence: Exploring Mars

Content	Teaching learning and assessment	Resources
ENGAGE	Watch the video Lesson 4 Exploring Mars (Perseverance) of Professor Alan Duffy explaining why we have been exploring Mars and what we have achieved so far. Lots of careers are involved in getting a rover to Mars. Draw a mind map with 'Careers in Space Exploration' in the middle and all the careers you can think of in this field around it. Expand this by adding the skills required in these careers.	QR code 8
EXPLORE	In February 2021, NASA landed their rover, Perseverance, on the surface of Mars. To do this, Perseverance had a landing system (learn about it). Entry, descent and landing (video)	QR code 9
	Watch the NASA Mars 2020 Perseverance Rover landing animations video or for more, watch the NASA Mars InSight landing animations video	QR code 10 QR code 11
	In pairs, review this land and note down the features required to safely land the rover on the surface. In your description, aim to discuss forces including gravity, weight and friction.	
	For information about Newton's Laws and Perseverance, visit Australia Science TV webpage Explainer: Landing rovers with Newton's laws.	QR code 12

Learning sequence: Exploring Mars (continued)

Content	Teaching learning and assessment	Resources
EXPLAIN	**Your task is to work in groups to design a landing system to safely deliver an egg-stronaut to the surface of Mars.** **The challenge:** You will work as a company to compete against others to develop the best lander for an egg-stronaut. You will have to consider the design very carefully to protect the egg-stronaut and not go over budget. The winning company will be the one who has demonstrated some great designs, safely landed their egg-stronaut and spent the least money. **Organise:** In groups, each member must have a specific role with certain responsibilities, just like in any job. Roles to choose from for this task are: Lead scientist, Design engineer, Mechanical engineer, Finance officer, Marketing specialist, Brand designer and Project manager (for smaller groups, combine the engineers and/or the marketing specialist and brand designer). **Marketing Specialist and Brand Designer:** Your first task as a company, is to come up with a company name. **Consider:** How does it let customers know what you do? Is it catchy and interesting? Make some sketches of a logo that will make your company recognisable. **Design a mission patch:** A mission patch is an emblem worn by astronauts and other personnel affiliated with that mission. Every space mission has its own unique mission patch. Each patch tells a small story; the parts of it all have meaning. **All other roles:** **Designing your lander:** Your company has access to some limited resources to build a lander. However, they come at a price. Each company has a budget of $500,000 which can only be spent with permission of the Finance Officer. They decide what can and cannot be purchased and ensure the build does not go over budget. Work together to sketch your ideas (four different ideas minimum per company). The Lead Scientist must ensure the lander designs are well suited to the scientific concepts discussed in the Explore section above. The Design engineer and Mechanical engineer must evaluate and combine the four initial concepts to create a final design. The finance officer can then approve the spend and purchase the materials required to prototype.	

Learning sequence: Exploring Mars (continued)

Content	Teaching learning and assessment	Resources
ELABORATE	**Challenge – Part 2: Prototyping** Use the resources available to build a prototype model of your lander. You can buy resources (if you have money left) and you can also negotiate to buy and sell items from other groups at cheaper prices. Make any changes to your design before you launch your egg-stronaut.	
EVALUATE	**Challenge – Part 3: The launch** Drop your egg-stronaut in your lander. Remove the egg-stronaut to see if it survived the journey. As a company, reflect on the land to evaluate what design features were successful and what could be improved. What science applications were done well? Discuss what would be done differently in future missions. Please consider sharing a video of your egg-stronaut launch with us! Email the Roots & Shoots team at rootsandshoots@janegoodall.org.au	
EXTEND	In reality, there are many iterations of prototypes, completed by computer models and physical models. Extend this activity by developing other models using the learnings from the first prototype to improve the landing system. Revised budgets could also be negotiated. The design team could also be tasked with coming up with a marketing promotion for their lander to bring in more funding.	

Learning sequence:

Moving To Mars

Learning intention:

Students can identify the requirements for sustaining life. Students use this knowledge to design and construct a model habitat for life on mars.

Success criteria:

All must be able to identify or describe the key resources needed for life to exist.

Most should be able to explain the difference in living conditions between Earth and Mars.

Some could identify new ways of obtaining the resources needed to sustain life.

Prior knowledge:

Living things needs

Properties of materials

KEY VOCABULARY

Habitat

Colonise

SPECIAL NOTES

Icons like this:

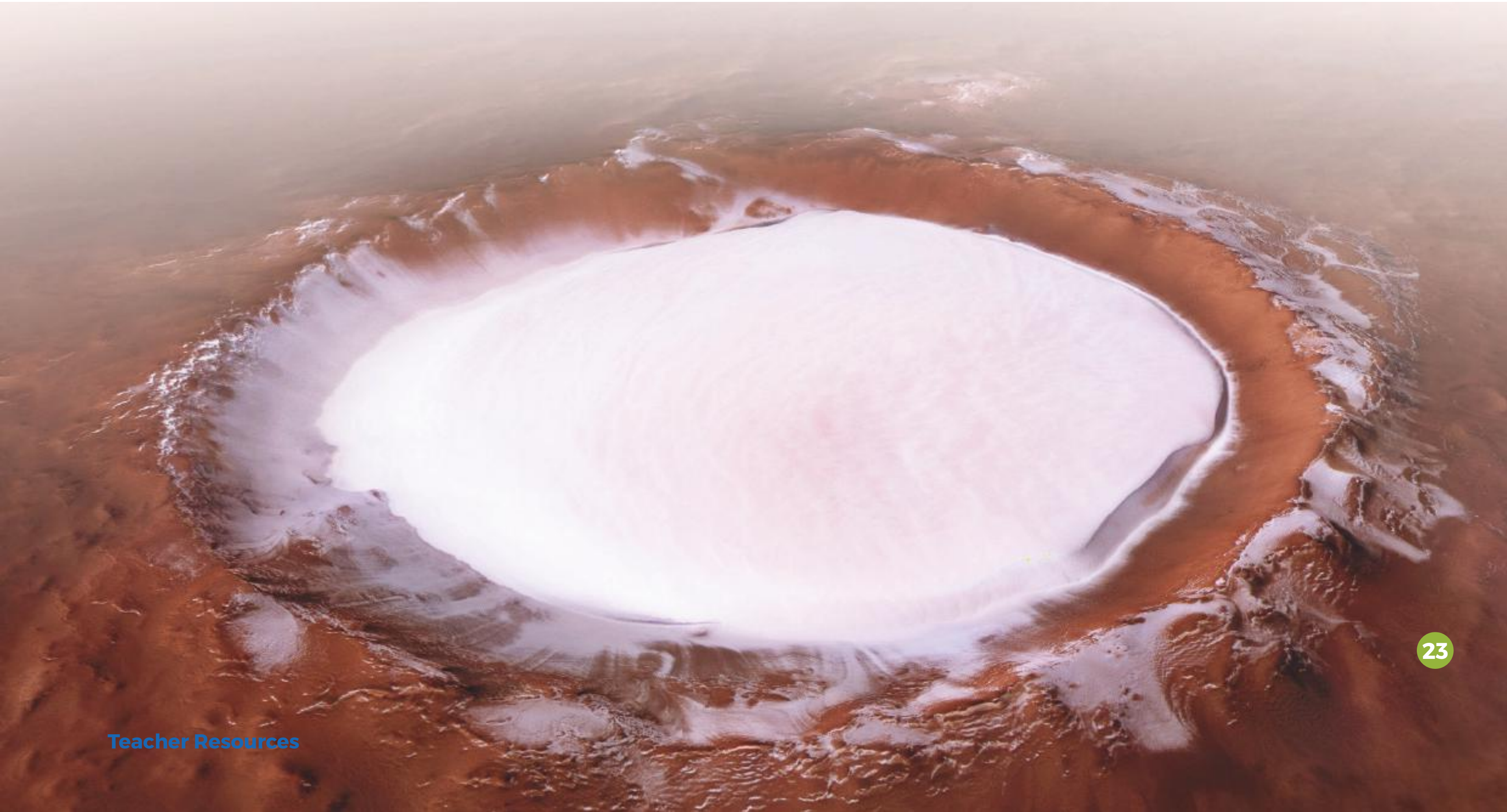
QR indicate a QR code link to online resources found in Appendix 3

Learning sequence: Moving To Mars

Content	Teaching learning and assessment	Resources
ENGAGE	Watch the video Lesson 5 Exploring Mars (Colonising) of Professor Alan Duffy explaining why we think we might be able to live on Mars. Think about the conditions on Mars as described in the book and in the video, use this information and your prior knowledge of the properties of materials to discuss the following: • What materials could you use form the planet itself? • What materials could you take with you, how will you transport them? • What shape will best suit your habitat building? • These questions should help you plan your design.	QR code 13
EXPLORE	**Explore this further by designing and making a model habitat building** **You will need:** • Pen, pencil, texters • Paper • Cardboard • Recycling materials • Sellotape, stapler, string • Plasticine/ modeling clay • Sticky notes/labels Method: 1. Create a diagram of your design, include labels. 2. Collect suitable materials as suggested above. 3. Construct a 3D model of your habitat building. Please consider sharing a photo of your model habitat building with us! Email the Roots & Shoots team at rootsandshoots@janegoodall.org.au	

Learning sequence: Moving To Mars (continued)

Content	Teaching learning and assessment	Resources
EXPLAIN	**Choose one of the following requirements for colonising Mars** • Oxygen • Water • Food Use the relevant chapter in the book and other resources available (e.g. internet, podcasts, videos, books) to identify new ways of obtaining these resources. Try to be as creative and imaginative as possible, ensure you can explain your methods. Present your ideas to the class. This can be in the form of a PowerPoint, a poster, a leaflet, a film, a podcast, a news article or other.	
ELABORATE	Your home (habitat) on Mars will need to include items which are both useful and perhaps keep you entertained. Think about the objects you have at home...are there any you couldn't live without? Choose three items and explain why you would want to take them to Mars. You may also want to consider how you would transport these items when making your choices.	
EVALUATE	Use the knowledge you have gained from what is required to live on Mars to consider the following questions: Would you want to go to Mars if it was a one-way trip? Should humans go to Mars or stay on Earth. Give reasons for your answers. Discuss these answers with the class.	
EXTEND	Following on from class discussion of the Evaluate questions above. Divide the class and plan a debate to further explore the answers to question two. Should humans go to Mars or stay on Earth?	



Appendix 3: QR codes to online resources

QR code 1
The observable universe

QR code 2
Unimaginable scale

QR code 3
The Scale of the Universe 2

QR code 4
Why are stars, planets and moons round?

QR code 5
Our solar system: The planets

QR code 6
Our solar system: Model the solar system

QR code 7
Our solar system: Earths rotations

QR code 8
Exploring Mars (Perseverance)

QR code 9
Entry, descent and landing

QR code 10

NASA Mars 2020 Perseverance Rover landing animations

QR code 11

NASA Mars InSight landing animations

QR code 12

Explainer: Landing rovers with Newton's laws

QR code 13

Exploring Mars (Colonising)

Jane Goodall's roots & shoots

Jane Goodall Institute Australia

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